



5. RISK ASSESSMENT

5.1 DMA 2000 Requirements and Approach

Requirement: §201.4(c)(2): Risk assessments that provide the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments. The risk assessment shall include the following:

5.2 Identifying Hazards

As a part of the update process, all of the hazards profiled in the original Plan were closely examined and screened by the Planning Team with regard to the following considerations:

- Prior knowledge of the relative risk associated with each of the hazards;
- Information from the hazard event database including any recent events occurring within the last three years;
- Comparison to hazards identified in local jurisdiction plans;
- The ability to effectively mitigate the hazard via the *DMA2000* process;
- The known or expected availability of information on the hazard;
- Duplication of the hazard's risk in other hazard definitions; and
- Whether or not the hazard is already being sufficiently addressed through other planning efforts of the State.

The prior knowledge of risks associated with each hazard summarized in the original Plan stem from both the collective experience of the Planning Team members and the information presented in the original Plan. For several hazards, an educated elimination can be made simply by the experience associated with that hazard as it applies to the State of Arizona. For instance, it is known and can be demonstrated that in the geologic past some areas of the State have been impacted by volcanic activity. However, consideration of volcanic activity as even a minor risk to State assets is not relevant, and therefore, the hazard associated with volcanic activity does not warrant further consideration.

For the development of our original Plan, a database of historical hazard events was developed using a variety of sources. The research was very thorough and involved such organizations as ADEM, The National Climate Data Center, National Weather Service, US Forest Service, to mention a few. As a result, the database grew to approximately 1,450 records, dating as far back to the year of 1849. Although the data provided useful resources for the analysis of historical hazards, for this update, we decided to include only events from 1966 to the present time. Due to the development of the State, we determined events from the last 40 years would prove more relevant to our current risks. After excluding events occurring prior to 1966, the list was approximately 1,100 records. Further record exclusion resulted when duplicate records were discovered. For example, the same event (wildfire) may be listed several times to indicate that it crossed city or county boundaries and/or the duration was more than 1 day, therefore listed twice. Due to these factors and the wide variety of sources used during the original Plan development, it is difficult to determine the level of accuracy regarding fatalities, injuries, and property damage. Therefore, the historic information should, at best, be considered representative of the total damage caused by the hazard event.

The hazard event database was populated in step-wise manner. The first step was to review records from ADEM, FEMA, and US Department of Agriculture (USDA), in order to identify and enter events that were declared a disaster or emergency by one or more of the following:

- Governor of Arizona;
- Secretary of the U.S. Department of Agriculture; or
- President of the United States.

Next, events were identified that, while not declared a disaster or emergency, caused sufficient one-time or repetitive damage to be considered a hazard (other events). In order to limit the number of entries in the second table below "Historical Record of Undeclared Disaster in Arizona, 1966-2006", the other events had to meet one or more of following criteria:

- 1 or more fatalities;
- 1 or more injuries;
- \$50,000 or more in damages; or
- significant event, as expressed in historical records or according to defined criteria.



The first three criteria are useful in order to screen the large number of hazard event records to include events from 1966 to the present. The last criteria enables the inclusion of historic hazard events which often have relatively little specific information, but were considered significant enough to have gone into one or more historical records. Such entries were typically from narrative descriptions cited in a wide variety of sources that had been identified by ADEM. Results from the historic hazard events database are summarized in the following tables:

Historical Record of Declared Disasters in Arizona, 1966 – 2006				
Hazard	Historical Records			
	Number	Recorded Damages		
	Total	Fatalities	Injuries	Total Expenditures
Dam Failure	2	0	0	\$349,053
Drought	17	0	0	\$311,395
Earthquake	1	0	0	\$25,000
Fissure	0	0	0	0
Flooding/Flash Flooding	43	20	115	\$315,114,105
Hazardous Materials Incidents	7	0	0	\$242,888
Landslides/Mudslides	1	0	0	\$7,762
Monsoon	3	0	0	\$21,785,045
Subsidence	0	0	0	0
Thunderstorms/High Winds	6	0	0	\$14,276,335
Tornadoes/Dust Devils	0	0	0	0
Tropical Storms/Hurricane	3	14	195	\$16,630,904
Wildfires	30	0	0	\$12,712,326
Winter Storms	9	8	0	\$21,641,568
Note: Declared disasters refers to Presidential, Gubernatorial and/or USDA. Fatalities, Injuries and Total Expenditures data can vary or be unavailable for some records and should be considered indicative. This table illustrates disaster declarations as well as hazards selected for further examination and profiling. Source: ADEM, 2007.				

Historical Record of Declared Disasters in Arizona, 2004 – 2007				
Hazard	Historical Records			
	Number	Recorded Damages		
	Total	Fatalities	Injuries	Total Expenditures
Dam Failure	1	0	0	\$344,165
Drought	0	0	0	0
Earthquake	0	0	0	0
Fissure	0	0	0	0
Flooding/Flash Flooding	3	0	0	\$885,113
Hazardous Materials Incidents	0	0	0	0
Landslides/Mudslides	0	0	0	0
Monsoon	2	0	0	\$5,058,940
Subsidence	0	0	0	0
Thunderstorms/High Winds	0	0	0	0
Tornadoes/Dust Devils	0	0	0	0
Tropical Storms/Hurricane	0	0	0	0
Wildfires	2	0	0	\$306,300
Winter Storms	3	0	0	\$7,342,382
Note: Declared disasters refers to Presidential, Gubernatorial and/or USDA. Fatalities, Injuries and Total Expenditures data can vary or be unavailable for some records and should be considered indicative. This table illustrates disaster declarations as well as hazards selected for further examination and profiling. Source: ADEM, 2007.				



Historical Record of Undeclared Disasters in Arizona, 1966 – 2006				
Hazard	Historical Records			
	Number	Recorded Damages		
	Total	Fatalities	Injuries	Total Expenditures
Flooding/Flash Flooding	19	16	135	\$8,850,460
Hail	9	0	6	\$18,800,000
Hazardous Materials Incidents	8	1	24	\$100,000,000
Lightning	48	9	68	\$5,839,000
Subsidence	1	0	0	\$3,000,000
Thunderstorms/High Winds	143	17	193	\$419,161,000
Tornadoes/Dust Devils	41	13	149	\$8,180,000
Tropical Storms/Hurricane	1	23	0	\$5,800,000
Wildfires	5	3	0	\$340,000
Winter Storms	7	9	15	\$2,150,000
Note: Records met 1 or more of the following criteria: 1 or more fatalities, 1 or more injuries or \$50,000 or more in Total Expenditures. Total Expenditures may include Property Damage and/or Crop/Livestock Damage. Fatalities, Injuries and Total Expenditures data can vary or be unavailable for some records and should be considered indicative.				
Source: ADEM, 2007				

Historical Record of Undeclared Disasters in Arizona, 2004 – 2007				
Hazard	Historical Records			
	Number	Recorded Damages		
	Total	Fatalities	Injuries	Total Expenditures
Flooding/Flash Flooding	7	2	11	\$3,600,000
Hail	1	1	0	0
Hazardous Materials Incidents	0	0	0	0
Lightning	11	3	3	\$1,250,000
Subsidence	0	0	0	0
Thunderstorms/High Winds	30	4	0	\$350,000,000
Tornadoes/Dust Devils	0	0	0	0
Tropical Storms/Hurricane	0	0	0	0
Wildfires	0	0	0	0
Winter Storms	1	3	0	0
Note: Records met 1 or more of the following criteria: 1 or more fatalities, 1 or more injuries or \$50,000 or more in Total Expenditures. Total Expenditures may include Property Damage and/or Crop/Livestock Damage. Fatalities, Injuries and Total Expenditures data can vary or be unavailable for some records and should be considered indicative.				
Note: The data recorded in this table is to be considered only indicative as a different source was used from the 1996-2006 table. Therefore, the information in both tables does not necessarily support each other. Further, this source is likely to be used for future updates of this Plan				
Source: NOAA Satellite & Info Svc website, 2007				

The profiles and historic hazard events summarized in each of the 15 county hazard mitigation plans were studied to aid in identifying and screening hazards to determine statewide risk. The presumption was that the importance given to hazards by the local communities, would and should inform the prioritization of hazards at the State level. According to the county plans, the top 5 hazards predominately identified were:

- Drought
- Flooding/Flash Flooding
- Thunderstorms/High Winds
- Tropical Storms/Hurricane
- Wildfires

These top five hazards indicated by information taken from the county plans are supportive of the hazards the Planning Team determined as the top five hazards statewide (see list below).



As a result of the review process and decision not to include human-caused hazards in this Plan, several hazards were removed. The hazards selected for removal are summarized below, along with a brief explanation of the reasoning used for the decision:

Disease

Disease is addressed in detail in the AZ Dept of Health Services (ADHS) Emergency Response Plan and its annexes. Concerns addressed include but are not limited to bioterrorism, pandemic influenza, antiviral distribution, etc. Due to the extent of the hazard coverage by ADHS, Disease was removed from this Plan.

Extreme Heat

Extreme heat is a way of life in most of Arizona and especially during the period between May and September. Consequently, the majority of the population is prepared to handle the heat as more of a seasonal occurrence rather than treating it as a hazard. Accordingly, for the purpose of this update, extreme heat will not be considered.

Hail

In Arizona, the occurrence of hail is usually associated with thunderstorms and for the most part is not significant enough to warrant a separate consideration. Less than 25% of hail storms that have occurred in the State has hail diameter in excess of two inches. In many cases, the damages associated with thunderstorm events involving significant hail also include severe wind and flooding. Accordingly, no separate consideration will be made for hail events.

Lightning

Lightning is one of the effects of severe thunderstorms and difficult to mitigate by itself. Therefore, for purposes of this update, lightning was not profiled separately. Lightning is included in the Thunderstorms/High Winds profile and Mitigation Strategy of this update of the Plan.

Severe Winds

Most severe winds that occur with Arizona are associated either with tropical storm, monsoon, thunderstorm and/or tornado events. Accordingly, this hazard is already addressed with other hazards and does not warrant a separate consideration.

Terrorism:

Terrorism is addressed by the AZ Dept of Homeland Security and more specifically in the "Homeland Security Plan - Securing Arizona" plan and strategies.

In an effort to provide as much information as possible about each hazard, text analysis as well as associated tables and graphics have been included in the hazard profiles that follow. These hazard profiles should be considered introductory, with additional and more detailed analysis available via the many sources cited below.

Due to the nature of certain hazards, a full quantitative vulnerability analysis was able to be performed only for Dam Failure, Flooding/Flash Flooding, Hazardous Materials Incidents and Wildfire in this Plan. A more qualitative approach was taken with the rest of the hazards profiled in this Plan. We will continue to analyze and gather information on the hazard profiles to eventually provide readers with the most complete Risk Assessment of each hazard possible. In most cases of the "remaining" hazards, a more narrative approach was taken as we found several of the hazards very difficult to look at in terms of quantity. This is will be a topic thoroughly examined during the development of the next update. Our goal is to determine a method for assessing each of the hazards in more detail to produce a reasonable product that makes sense. This may take some time and we will complete as many hazards as we are able to in each update.

As a result of the screening/identification process, the following list of hazards was selected for continuance in the profiling and vulnerability assessment phases of the overall risk assessment for this Plan update (bold text indicates Arizona's top hazards):

- Dam Failure
- **Drought**
- Earthquake
- Fissure
- **Flooding/Flash Flooding**
- Hazardous Materials Incidents
- Landslides/Mudslides
- Monsoon
- Subsidence
- **Thunderstorms/High Winds**
- Tornadoes/Dust Devils
- **Tropical Storms/Hurricane**
- **Wildfires**
- Winter Storms



We recognize the relation between several of the hazards profiled in this Plan. For instance, monsoon is typically a seasonal thunderstorm, not necessarily an actual hazard event as an earthquake is. Including monsoon in the Plan as a hazard event was debated by the Planning Team. In the end, it was decided to keep it in and analyze the hazard topic further during the development of the next update. It is not likely to remain in our Plan after this update. The same applies to Winter Storms which is not a hazard in itself, but encompass other elements that are not necessarily accurately portrayed by placing it all under this title. For these reasons and to illustrate the other impacts of hazards, we have included the table below. Most of this information can also be found in the hazard profiles that follow. This information will be incorporated into profiles where not already available during development of the next update.

Event	Problem	Immediate/Short-Term Secondary Dangers	Longer Term Secondary Dangers
Drought	Drought	Wildfire	Dust Storms, Flooding/Flash Flooding, Subsidence
Dam Failure	Dam Failure	Flooding/Flash Flooding	
Earthquake	Earthquake	Landslide/Mudslides	
Fissure	Fissure		
Flooding/Flash Flooding	Flooding/Flash Flooding	Landslide/Mudslides	
Hazardous Materials Incidents	Hazardous Materials Incidents		
Landslide/Mudslides	Landslide/Mudslides	Flooding/Flash Flooding	
Monsoon	Thunderstorm/High Winds (Lightning, rain, wind)	Flooding/Flash Flooding	
Subsidence	Subsidence	Flooding/Flash Flooding	
Thunderstorm/High Winds	Thunderstorm/High Winds (Lightning, rain, wind)	Flooding/Flash Flooding, Wildfires	
Tornadoes/Dust Storms	High winds		
Tropical Storms/Hurricane	Heavy rain, high winds	Flooding/Flash Flooding	
Wildfires	Wildfires		Flooding/Flash Flooding
Winter Storms	Snowfall, freezing rain and low temperatures	Flooding/Flash Flooding	